PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference -?-	**FOR FURTHER ACTION** See Form PCT/IPEA/416	
International application No. PCT/DK2004/000849	International filing date *(day/month/year)* 07.12.2004	Priority date *(day/month/year)* 08.12.2003
International Patent Classification (IPC) or national classification and IPC INV. H01L23/427 H01L23/473		
Applicant NOISE LIMIT APS et al.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 2 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in celectronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☒	Box No. VII	Certain defects in the international application
☒	Box No. VIII	Certain observations on the international application

Date of submission of the demand 27.10.2005	Date of completion of this report 30.03.2006
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Edmeades, M Telephone No. +49 89 2399-2731

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/DK2004/000849

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:

   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages	
1-15	as originally filed
Claims, Numbers	
1-16	received on 29.10.2005 with letter of 29.10.2005
Drawings, Sheets	
1-11	as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/DK2004/000849

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	3-6,10,12,14
	No:	Claims	1,2,7-9,11,13,15,16
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-16
Industrial applicability (IA)	Yes:	Claims	1-16
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

SECTION V

1. Reference is made to the following documents:

D1: US-A-3 609 991 (RICHARD CHU ET AL) 5 October 1971 (1971-10-05)
D2: US-A-5 427 174 (LOMOLINO, SR. ET AL) 27 June 1995 (1995-06-27)
D3: GB-A-1 201 297 (IBM) 5 August 1970 (1970-08-05)
D4: US-A-2003/0192674

2. D2 discloses (see Fig.3 and corresponding text and Col.9, l.36-60) a device comprising

a first heat-receiving part 60; heat emitting element (not shown); cooling fluid 67; hermetic seal (Col.12, l.48); bubble pump with tube shaped part (66,68,70) downstream of heat-receiving part; radiator 59; condenser 54,58. From the description of the operation of the bubble pump at Col.13, it is considered that, in operation, the bubbles move liquid cooling fluid at substantially the same velocity as the bubbles in the tube-shaped part.

Figures 5,6 and corresponding text disclose the same features in an alternative form, in which tube-shaped part 370,390 generates flow by the motive forces of bubbles (Col.17, l.52-65).

3. D2 also discloses the additional features of claims 2,7-9,11,13,15,16.

4. D1 discloses (see Fig.1 and corresponding text) a device comprising all of the features of claim 1: first heat-receiving part 16; heat emitting element 14; cooling fluid 28; bubble pump 30; tube-shaped part 30; bubbles 60; radiator 24,46,48; condenser 44.

Moreover, since the physical features of the bubble pump disclosed in D1 are identical to those of claim 1, it is considered that the flow of fluids and bubbles will also be the same, i.e bubbles and fluid flowing at substantially the same velocity.

Hence claim 1 differs from the disclosure of D1 in that the system is hermetically sealed. This difference does not involve an inventive step, residing in a trivial difference over the prior art that has nothing to do with the technical problem addressed by the application. In any case, the use of hermetically sealed bubble pumps systems is conventional - see D2, Col.9, l.36-61 - and would be incorporated into the design of D1 without the requirement of an inventive step.

5. D1 also discloses the additional features of claims 2,3,4,5,6,13,14,15,16.

6. Claims 10-12: D1 is silent on the pressures employed in the system. However, the skilled person knows from comparable systems such as D3 (see page 2, lines 52-79) that low pressure systems ("at or around atmospheric") may be employed.

7. D4 discloses relevant information regarding the type of fluids that could be utilized in a tube-based bubble pump - see [0040] - [0045].

SECTION VII

1. By placing the expression "by the motive forces ... in the tube-shaped part" in the characterizing part of claim 1, the applicant is implying that there is a technical difference in the functioning of the claimed apparatus and that of the prior art, in particular D1.
However, no such difference is apparent. Moreover, if a difference could be shown, then there would be a deficiency under Article 5 PCT, because the application does not describe how apparently identical apparatuses can function in a different manner.

SECTION VIII

1. Claim 1 is directed to a cooling system, but contains features related purely to the operation of a cooling system ("by the motive force ... as the bubbles"). Hence the category of the claim is uncertain and the claim unclear.

CLAIMS

1. Cooling system (100, 110, 120, 130, 140, 150) for cooling of at least one heat-emitting element, comprising

a first heat-receiving part (6) that is adapted to receive heat from the at least one heat-emitting element,

a cooling fluid (4) for absorption of heat by heating and evaporation,

c h a r a c t e r i z e d in that the system is hermetically sealed and further comprises

a bubble pump (1) with a tube-shaped part for generation of a fluid flow in the system by the motive forces of bubbles moving liquid cooling fluid at substantially the same velocity as the bubbles in the tube-shaped part, the tube-shaped part being positioned downstream the first heat-receiving part (6) and moving the cooling fluid (4) towards

a radiator (2, 9) for emission of heat from the cooling fluid in liquid form to the surroundings, and

a condenser (2, 10) for condensing of evaporated cooling fluid (3) and emission of the heat of condensation.

2. Cooling system (100, 110, 120, 130, 140, 150) according to claim 1, wherein the bubble pump has an outlet (5), wherein the outlet (5) during operation of the cooling system is positioned above the liquid level of the system.

3. Cooling system (100, 110, 120, 130, 140, 150) according to any of claims 1 or 2, further comprising a second heat-receiving part (7) for accommodation of a heat-emitting element.

4. Cooling system (100, 110, 120, 130, 140, 150) according to any of the claims 1 to 3, further comprising a plurality of bubble pumps (1a, 1b).

5. Cooling system (100, 110, 120, 130, 140, 150) according to claim 3, wherein at least some of the bubble pumps are connected in series.

6. Cooling system (100, 110, 120, 130, 140, 150) according to claim 4 or 5, wherein at least some of the bubble pumps are connected in parallel.

7. Cooling system (100, 110, 120, 130, 140, 150) according to any of the preceding claims, wherein the cooling fluid (4) comprises at least two fluids with different boiling points.

8. Cooling system (100, 110, 120, 130, 140, 150) according to any of the preceding claims, wherein a first fluid in the cooling fluid (4) is selected from the group of ethanol, methanol, acetone, ether and propane

9. Cooling system (100, 110, 120, 130, 140, 150) according to any of the preceding claims, wherein a second fluid in the cooling fluid (4) is water.

10. Cooling system (100, 110, 120, 130, 140, 150) according to any of the preceding claims, wherein the pressure in the cooling system (100, 110, 120, 130, 140, 150) is adjusted to a desired pressure.

11. Cooling system (100, 110, 120, 130, 140, 150) according to claim 10, wherein the pressure is adjusted so that the lowest boiling temperature of the fluids substantially equals the desired operating temperature of the at least one heat-emitting element.

12. Cooling system (100, 110, 120, 130, 140, 150) according to claim 10 or 11, wherein the pressure in the cooling system is lower than the atmospheric pressure.

13. Cooling system (100, 110, 120, 130, 140, 150) according to any of the preceding claims, wherein a heat-emitting element is integrated in the heat-receiving part (6, 7) and is in direct contact with the cooling fluid (4) in the cooling system.

14. Cooling system (100, 110, 120, 130, 140, 150) according to any of the preceding claims, wherein the heat-receiving part comprises a plurality of separated liquid chambers.

15. Electronic device having one or more elements to be cooled during the operation of the electronic device, wherein the electronic device comprises a cooling system (100, 110, 120, 130, 140, 150) according to any of the claims 1 to 14.

16. Use of a cooling system (100, 110, 120, 130, 140, 150) according to any of the claims 1 to 14 for cooling of electronic components.